INVESTOR IN PEOPLE

6B04/1472

The Patent Office
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Cardiff Road
Newport
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Dated 26 May 2004

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**tents Form 1/77**

Patents Act 1977
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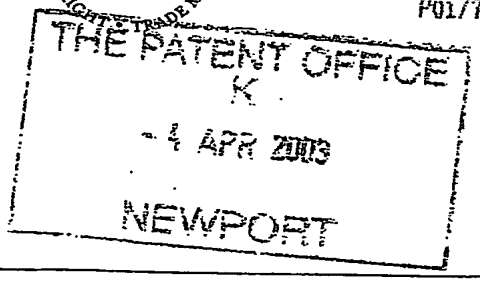


1/77

P01/7700 0.00-0307766.6

# Request for grant of a patent

*(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)*

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

AS\AM\P12841GB

2. Patent application number
*(The Patent Office will fill in this part)*

0307766.6

-4 APR 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

CHURCHILL DRILLING TOOLS LIMITED
33 ST SWITHIN STREET
ABERDEEN
AB10 6XL
SCOTLAND
UNITED KINGDOM

Patents ADP number *(if you know it)*

8558934001

If the applicant is a corporate body, give the country/state of its incorporation

UNITED KINGDOM

4. Title of the invention

DRIFTING TUBING

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

CRUIKSHANK & FAIRWEATHER
19 ROYAL EXCHANGE SQUARE
GLASGOW
G1 3AE
SCOTLAND
UNITED KINGDOM

Patents ADP number *(if you know it)*

547002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

| Country | Priority application number *(if you know it)* | Date of filing *(day / month / year)* |
|---|---|---|

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

| Number of earlier application | Date of filing *(day / month / year)* |
|---|---|

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

*a) any applicant named in part 3 is not an inventor, or*
*b) there is an inventor who is not named as an applicant, or*
*c) any named applicant is a corporate body.*
*See note (d))*

YES

**Patents Form 1/77**

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

| | |
|---|---|
| Continuation sheets of this form | |
| Description | 11 |
| Claim(s) | |
| Abstract | |
| Drawing(s) | 5 + 5 ✓ |

10. If you are also filing any of the following, state how many against each item.

| | |
|---|---|
| Priority documents | |
| Translations of priority documents | |
| Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* | |
| Request for preliminary examination and search *(Patents Form 9/77)* | |
| Request for substantive examination *(Patents Form 10/77)* | |
| Any other documents *(please specify)* | |

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date

CRUIKSHANK & FAIRWEATHER 3 APRIL 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

ANDREW SHANKS
0141 221 5767

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e) *Once you have filled in the form you must remember to sign and date it.*

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# DRIFTING TUBING

## FIELD OF THE INVENTION

This invention relates to drifting tubing, that is the process of determining whether the bore of a length of tubing is restricted or obstructed.

## BACKGROUND OF THE INVENTION

In the oil and gas exploration and production industry long strings of jointed tubing or pipe are utilised to carry fluids between the surface and downhole locations within drilled bores, which strings and bores may be several kilometres long. In a number of downhole operations there is a possibility of the pipe bore becoming restricted by, for example, cement residue or precipitates. Accordingly, after such operations it is necessary to inspect the pipe for the presence of any such restrictions, and this is normally achieved by checking the pipe string in stages as the string is pulled out of the bore and the pipe sections are separated at surface. Pipe strings are normally formed of large numbers of pipe sections that are typically around 10 metres long and have threaded ends. The pipe sections are often made up and stores as "stands", each formed of three pipe sections, and thus around 30 metres long. Accordingly, when a pipe string is being pulled out of a bore, the string is lifted in 30 metre stages, to allow the uppermost stand to be removed.

One known method of checking the pipe bore for restrictions is to drop a sleeve on a 40 metre length of wire into the upper end of the pipe string. The pipe string is then pulled out of the bore to allow removal of the top pipe stand. If the wire is visible when the stand is separated from the string the operator knows the sleeve is in the next stand and the stand that has been separated from the string is unobstructed. This operation may be carried out relatively rapidly, but on occasion the sleeve will not drop through the pipe, even when there is no restriction present, and the supporting wire may become tangled.

In another method, an operator working at an elevated level simply drops an object, or drift, through each pipe stand as it is being racked. The drift is retrieved at the bottom of the stand and then returned to the operator by means of the elevators used to lift the pipe out of the bore. This process is relatively slow, and it is not unknown for the drift to be dropped or otherwise fall, at significant risk to operators working below.

It is among the objectives of embodiments of the present invention to provide a more efficient and safer method for drifting tubing.

## SUMMARY OF THE INVENTION

According to the present invention there is provided a method of checking for restrictions in a length of tubing, the method tubing comprising;

providing tubing defining a profile therein;

providing a drift member adapted to engage with said tubing profile;

Thus, even with the drift member engaged with the profile, or engaged with a restriction, fluid may pass through the member. This permits fluid to drain from the tubing through the member and, if necessary, for fluid to be passed through the tubing. In certain embodiments, the drift member may have a configuration adapted to prevent or significantly restrict fluid flow: the member may incorporate a burst disc or the like which initially serves to occlude the tubing, but which may be removed or otherwise opened.

Preferably, engagement of the drift member with the profile restricts fluid flow through the tubing, which restriction is remotely detectable. Where the tubing extends downhole, engagement of the member with the profile may be identified as a rise in pump pressure at surface.

Preferably, the drift member comprises a sleeve or the like incorporating a flow restriction, such as a nozzle or orifice, adapted to create a fluid pressure differential in fluid passing therethrough. The flow restriction may be defined by a hardened or otherwise erosion-resistant material.

Preferably, the drift member is adapted to be retrievable from the tubing. The member may incorporate a profile, more particularly a fishing profile, to facilitate withdrawal of the member from the tubing.

The tubing profile may be formed integrally with a portion of the tubing, for example the tubing may incorporate a section or sub which defines the profile. Alternatively, the profile may be defined by a member, such as a ring or sleeve, adapted to be located within a section of tubing, which section of tubing may be adapted to receive the member.

Such a profile member may thus be removed and replaced when worn or damaged, or when it is desired to employ a different form of drift member. Alternatively, the profile may be defined by a member adapted for location in conventional tubing, and preferably adapted for location at a connection between tubing sections, particularly in a female or box connection. The profile member will thus be readily accessible when the tubing is disassembled, and may be located in a tubing string at an appropriate location while the string is being made up. Conveniently, the profile member may be located in a stress relief profiled section of a box connection.

The profile member may be adapted to form a seal with the tubing.

The drift member may be adapted to form a seal with the profile, such that any fluid flowing through the tubing when the drift member is engaged in the profile must flow through the drift member. This will ensure the presence of a predictable or predetermined pressure drop when the drift member is correctly located in the profile, facilitating differentiation from occasions when the drift member encounters and is restrained by a restriction in the tubing before reaching the profile.

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of apparatus for identifying bore restrictions in tubing, in accordance with an embodiment of the present invention and showing a drift member located externally of a profiled sub;

Figure 2 is an enlarged sectional view of the drift member of Figure 1;

Figure 3 is a sectional view of apparatus for identifying bore restrictions in tubing, in accordance with a further embodiment of the invention;

Figure 4 is a sectional view of apparatus for identifying bore restrictions in tubing in accordance with a still further embodiment of the present invention; and

Figure 5 is an enlarged sectional view of the drift member of Figure 4.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference is first made to Figure 1 of the drawings, which illustrates apparatus for use in identifying bore restrictions in tubing, in accordance with an embodiment of the present invention. The apparatus 10 comprises a sub 12 and a drift member in the form of a drift sleeve 14 adapted to engage within the sub 12, as will be described.

The sub 12 is intended for incorporation in the lower end of a string of conventional drill pipe, and thus incorporates conventional pin and box connections 16, 17, and defines a central through bore 18. However, the bore 18 defines a profile in the form of a shoulder 20 arranged to receive and engage the drift sleeve 14, which is illustrated externally of the sub 12 in Figure 1.

The drift 14 is illustrated in greater detail in Figure 2 of the drawings, and comprises a generally cylindrical body 22 with a slightly

tapered leading end 24, whereas the trailing end 26 defines an external profile 28 for co-operation with the sub shoulder 20 and an internal fishing profile 20. An internal ledge 32 within the sleeve body 22 supports a hardened nozzle ring 34 which is in sealing engagement with the inner wall of the sleeve body 22.

In use, as a pipe string is made up and lowered into a drilled bore, the sub 12 is incorporated in the string, at or towards the leading or distal end of the string. Once the operation requiring use of the string have been completed, and before the string is pulled out of the bore and disassembled, the drift sleeve 14 is inserted into the string bore at surface and pumped down through the string. If the string bore is substantially free from obstruction or restriction, the sleeve 14 will pass down through the string until it encounters the drift sub 12, where the sleeve profile 28 will engage the sub shoulder 20 and prevent further travel of the sleeve 14. The sub bore 18 and the sleeve external configuration are such that the sleeve 14 is substantially a sealing fit within the sub 12, such that any fluid passing through the string from surface must then pass through the nozzle 34, and will therefore experience a pressure drop. The restriction introduced into the string bore by the nozzle 34 is reflected at surface by an increase in pump pressure, which indicates to the operators on surface that the sleeve 14 has engaged within the sub 12, and that the pipe string is substantially free of obstruction and restriction.

However, where the pipe string has been restricted or obstructed by, for example, cement residue, the sleeve 14 will not be able to pass

the restriction to reach and engage with the sub 12. In such circumstances, the sleeve 14 will of course still create a restriction in the pipe string bore, however the sleeve 14 will not sealingly engage with the pipe above the restriction, such that fluid will flow around as well as through the sleeve 14. Thus, while the engagement of the sleeve 14 with a restriction may be reflected in the detection of an increase in pump pressure at surface, this increase will be noticeably less than the pressure increase that would be expected if the sleeve 14 were to engage and locate within the drift sub 12. Accordingly, the operators are then alerted to the fact that the string bore is restricted or obstructed. In this case, which it is expected will occur in perhaps 1 in 10 runs of a drift sleeve 14, the pipe string can be checked for obstructions on a stand-by-stand basis, in a conventional manner, as described above.

Of course, in the perhaps 9 out of 10 cases in which the drift sleeve 14 passes through the string to engage within the drift sub 12, it is not necessary for the operator to check the string bore as the string is disassembled on surface, providing a significant saving in time and thus expense.

Reference is now made to Figure 3 of the drawings, which illustrates apparatus 40 for use in identifying bore restrictions in tubing, in accordance with a further embodiment of the invention. The apparatus 40 is substantially similar to the apparatus 10 described above, however, rather that incorporating an integral profile or shoulder 20, as in the drift sub 12, the drift sub 42 of this embodiment is provided with an insert 44 that defines an internal profile 46 adapted to engage a

corresponding profile 48 on the drift sleeve 50. The insert 44 sits on a ledge 52 defined within the sleeve bore and also carries external seals 54 to ensure that no fluid passes between the sleeve 44 and the sub bore wall.

The provision of an insert 44 allows the profile 46 to be modified to suit different drift sleeve configurations, and of course the insert 44 may be replaced in case of erosion or damage.

Reference is now made to Figures 4 and 5 of the drawings, which illustrate apparatus for identifying bore restrictions in tubing in accordance with a still further embodiment of the present invention. In this embodiment, there is no requirement to provide a specially adapted drift sub, as the profile 60 for engaging with the drift member, in this example in the form of a cylindrical drift dart 62, is adapted to be located within a conventional pipe section, and in particular within the "bore back" box connection 64 of a pipe section 66. This particular form of box is a common feature on pipe sections, intended to reduce fatigue at the connection.

The profile 60 is defined by a nozzle ring 68 which may be located within the box connection 64 during the make-up of the pipe string, the ring 68 forming a sealing fit with the inner wall of the connection 64.

The drift dart 62 comprises a generally cylindrical body 70 having a tapering leading end 72 and defining an external profile 74 adjacent the leading end 72, for engaging with the profile 60. The trailing end 76 incorporates a burst disc 78 and features external flexible fins 80 which

assist in stabilising the dart 62 as it is pumped through the tubing string.

In use, the dart 62 is inserted into the tubing string bore at surface and is then pumped down through the string. If there are no significant bore restrictions or obstructions the dart 62 will pass through the string until it engages with the profile 60. This will be reflected by a sharp increase in pump pressure at the surface, which will be readily detectable by the operators. By increasing the pump pressure further the operators may burst the disc 78, such that fluid may drain from the tubing string as it is withdrawn and dismantled.

If, on the other hand, the dart 62 encounters a restriction or obstruction before reaching the profile 60, there will be an increase in pump pressure at surface, however as the dart 62 will not form a substantially sealing fit with the restriction or the obstruction, the increase in pressure will be less than that which would be expected were the dart 62 to engage with the profile 60. Accordingly, the operators will be alerted to the fact that there is a restriction or an obstruction in the string bore, such that the bore should be checked as the string is pulled out of the bore.

It will be apparent to those of skill in the art that the above-described embodiments of the present invention provide a relatively rapid means for determining whether there is any significant restriction or obstruction present in a tubing string. The operation may be carried out easily and safely while the tubing string remains in the bore, and the form of the drift member is such that in the presence of the drift member

within the string will not interfere or complicate the subsequent pulling out and disassembly of the string. As noted above, in the great majority of cases where no significant restriction or obstruction is likely to be identified, the operator may then disassemble the string with the knowledge that no restrictions or obstructions are present, and the normal checks for restrictions need not be carried out.

It will also be apparent to those of skill in the art that the above-described embodiments are merely exemplary of the present invention, and that various modifications and improvements may be made thereto without departing from the scope of the invention.

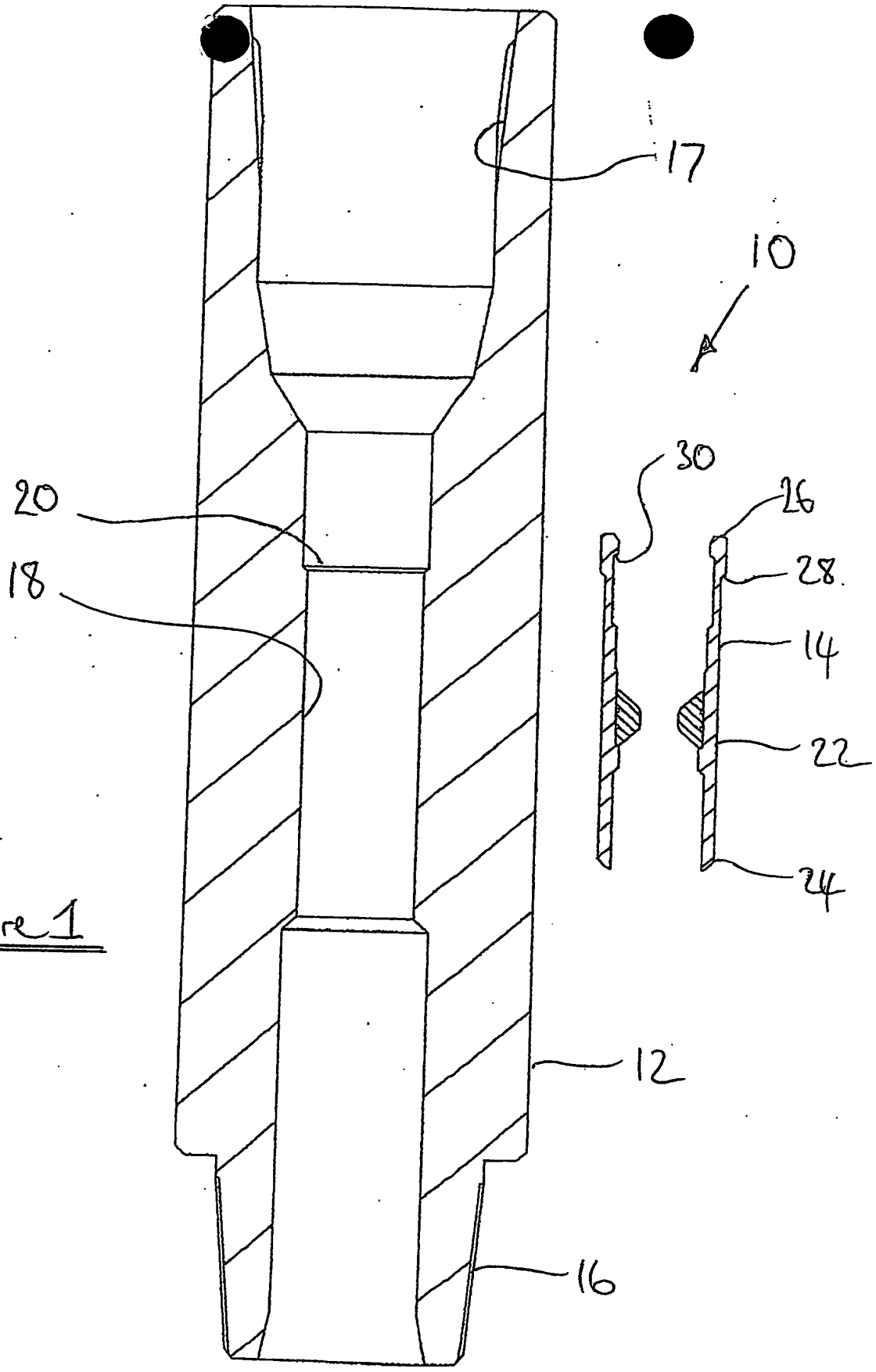


Figure 1

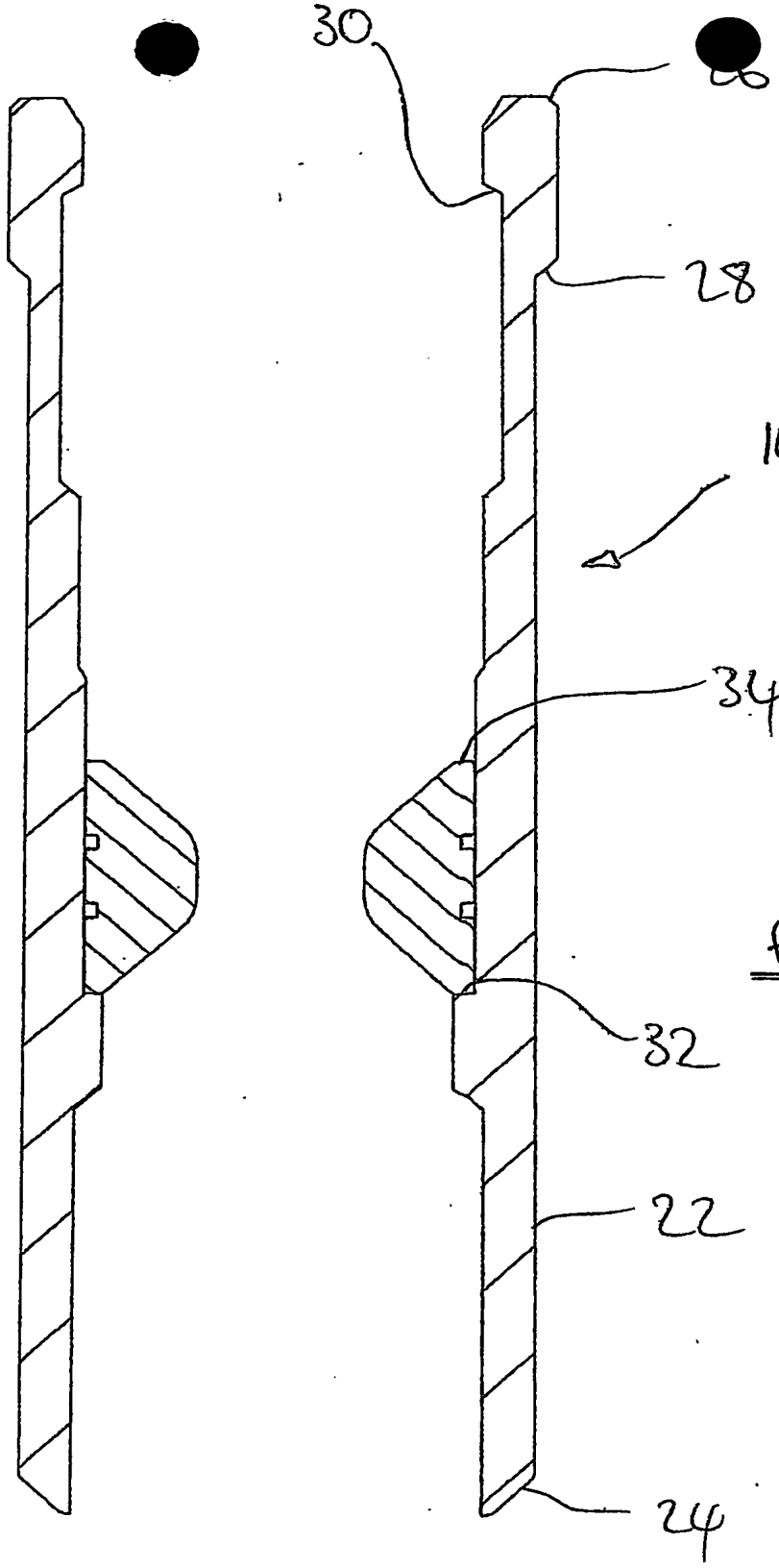


Figure 2

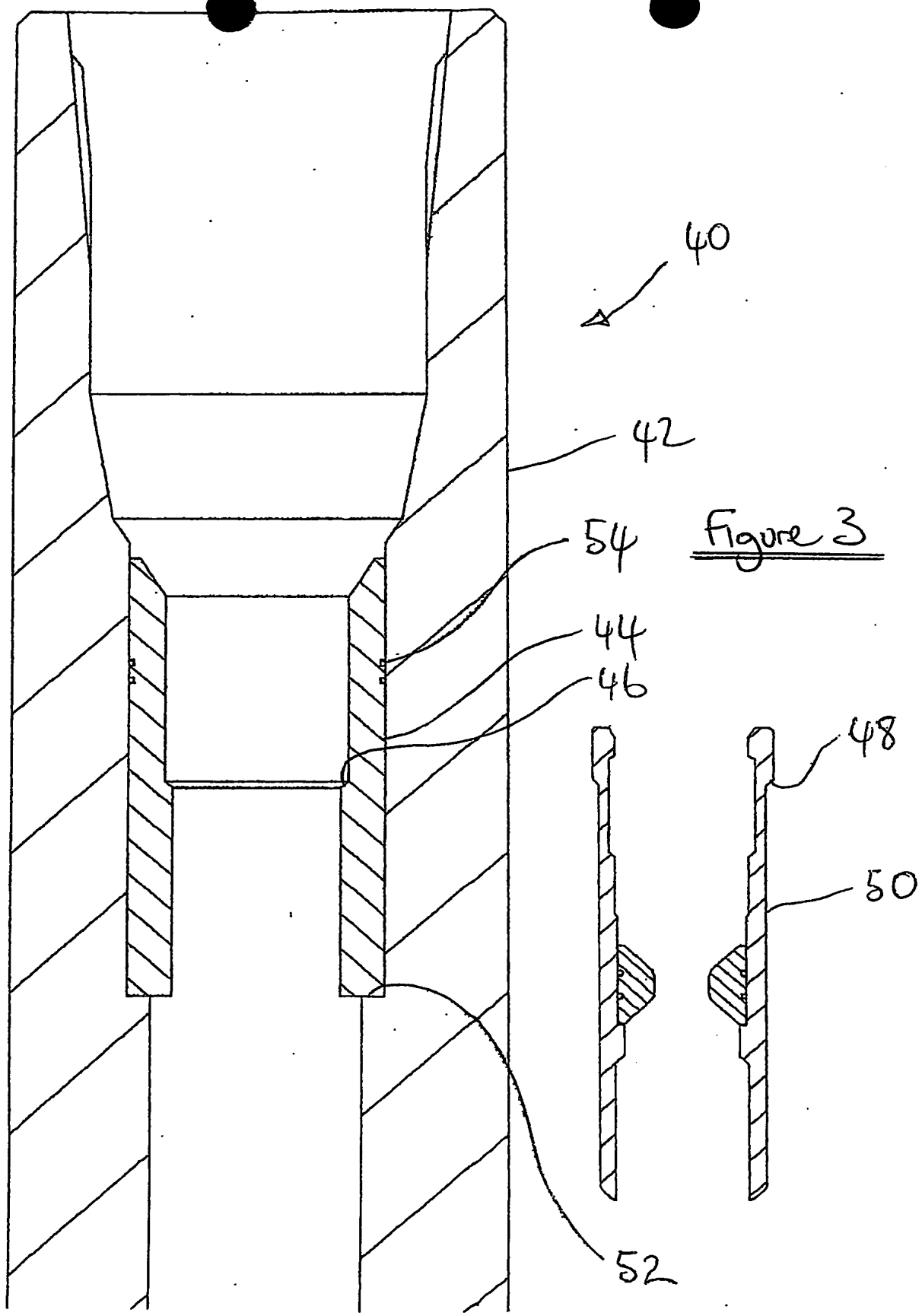


Figure 3

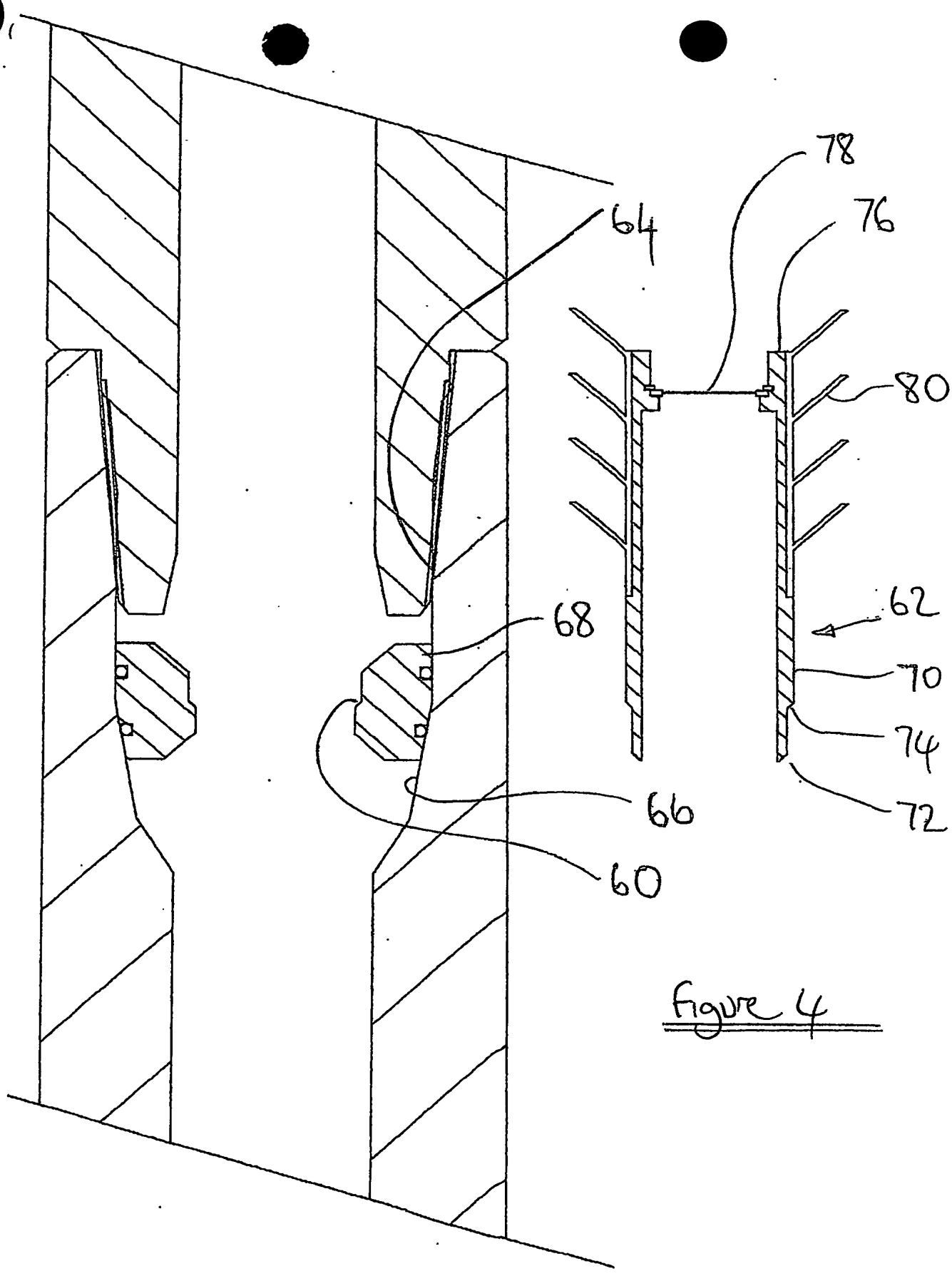


Figure 4

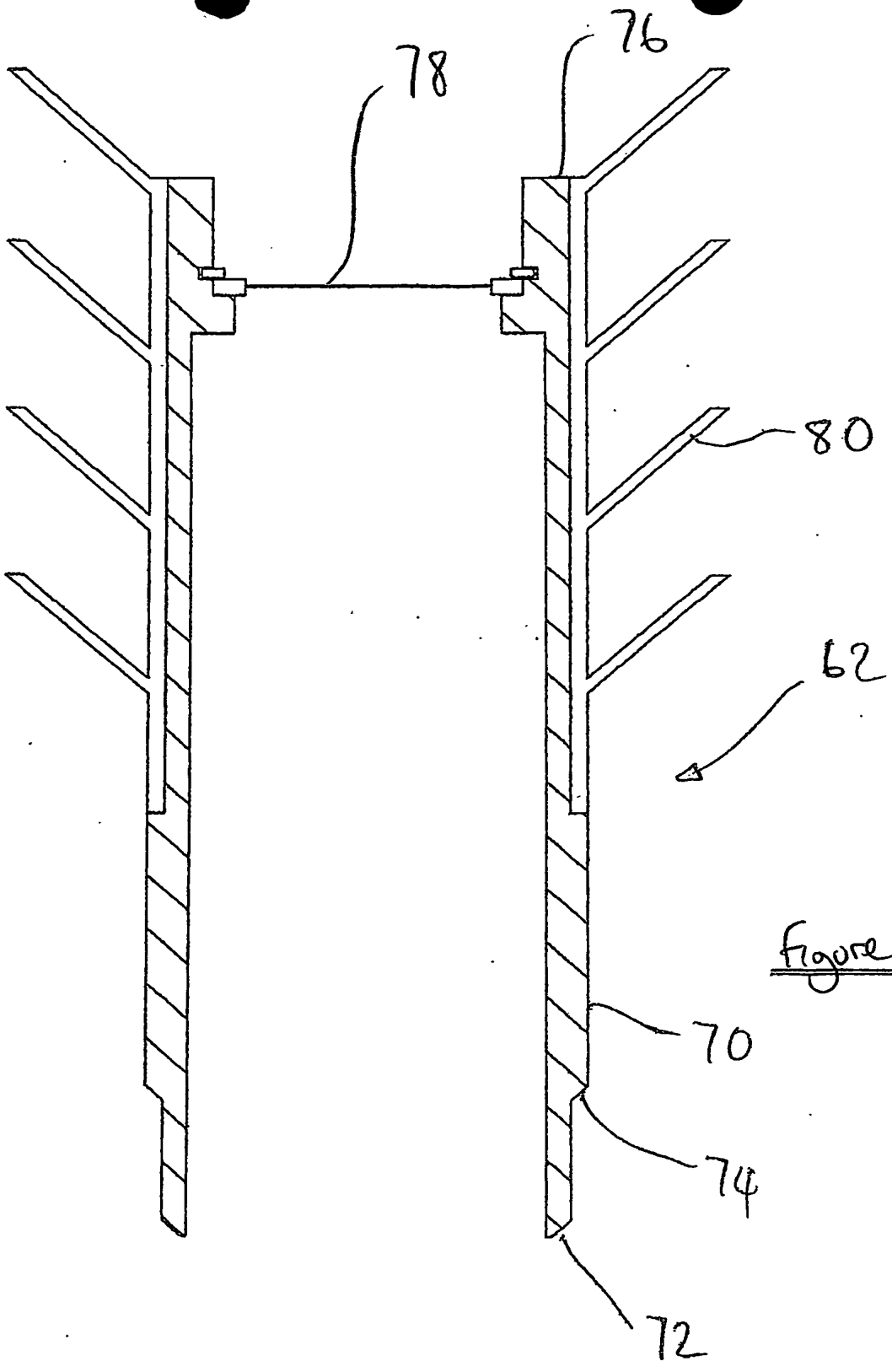


Figure 5